WHAT IS CLAIMED IS:

1. A fluid flow control device comprising:

(a) a substrate having an upper surface adapted to contact a flowing fluid;

(b) an elastic sheet having an upper surface and an opposing lower surface, with the lower surface facing the upper surface of the substrate, wherein the elastic sheet (i) is immobilized with respect to the substrate at a minimum of two immobilization points, and (ii) has a deflectable active area at least partially contained between the immobilization points; and

(c) an actuation means for deflecting the active area of the elastic sheet away from the upper surface of the substrate.

2. The device of claim 1, wherein the upper surface of the substrate is substantially planar.

3. The device of claim 1, further comprising a fluid-transporting feature on the upper surface of the substrate and at least partially contained between the immobilization points.

4. The device of claim 3, wherein the fluid-transporting feature is located entirely within a bounded region defined by the immobilization points.

5. The device of claim 3, wherein the fluid-transporting feature is a microfeature.

6. The device of claim 5, wherein the microfeature is a microchannel or a microconduit.

7. The device of claim 3, comprising a plurality of fluid-transporting features on the upper surface of the substrate and at least partially contained between the immobilization points.

8. The device of claim 1, wherein the substrate has a rigidity of at least 10 times that of the elastic sheet.

9. The device of claim 1, wherein the substrate is comprised of a material selected from the group consisting of metals, ceramics, semiconductors, polymers, composites thereof, and laminates of any of the foregoing.

10. The device of claim 1, wherein the elastic sheet is comprised of a polymeric material.

11. The device of claim 10, wherein the polymeric material is an elastomer.

12. The device of claim 11, wherein the elastomer is selected from silicones, urethanes, fluorinated polymers, nitrile rubbers, alkylene rubbers, diene rubbers, copolymers thereof, and mixtures of any of the foregoing.

13. The device of claim 1, wherein the elastic sheet has a substantially uniform thickness.

14. The device of claim 1, wherein at least the active area of the elastic sheet is prestrained.

15. The device of claim 14, wherein the entire elastic sheet is prestrained.

16. The device of claim 1, wherein the actuation means comprises a nonmechanical actuation means.

17. The device of claim 16, wherein the nonmechanical means comprises a means for applying an electric field to the active area.

18. The device of claim 17, further comprising two electrodes in contact with the active area of the elastic sheet wherein the actuation means is operatively connected to the electrodes.

19. The device of claim 18, wherein the electrodes are located on opposing surfaces of the elastic sheet.

20. The device of claim 18, wherein at least one of the electrodes is comprised of a plurality of electrically conductive particles in electrical communication with each other and adhered to the active area.

21. The device of claim 20, wherein the electrically conductive particles are comprised of carbon.

22. The device of claim 18, wherein at least one of the electrodes is comprised of a metallic film deposited on the upper or lower surface of the elastic sheet with at least a portion of the metallic film deposited within the active area.

23. The device of claim 16, wherein the actuation means is adapted to deflect the active area through a linear strain of at least about 10 percent.

24. The device of claim 23, wherein the actuation means is adapted to deflect the active area through a linear strain of at least about 50 percent.

25. The device of claim 1, wherein substantially the entire elastic sheet except for the active area is immobilized with respect to the substrate.

26. The device of claim 1, wherein the upper surface of the elastic sheet represents an exterior surface of the device.

27. The device of claim 1, wherein the lower surface of the elastic sheet, prior to actuation, contacts the upper surface of the substrate.

28. The device of claim 27, wherein the lower surface of the elastic sheet, prior to actuation, conforms to the upper surface of the substrate.

29. The device of claim 1, wherein the lower surface of the elastic sheet, after actuation and in combination with the upper surface of the substrate, forms a fluid-transporting feature.

30. The device of claim 1, wherein the lower surface of the elastic sheet, prior to actuation and in combination with the upper surface of the substrate, forms a fluid-transporting feature.

31. The device of claim 29, wherein the fluid-transporting feature is a conduit.

32. The device of claim 29, wherein the fluid-transporting feature is a chamber.

33. The device of claim 29, wherein the fluid-transporting feature is a microfeature.

34. The device of claim 29, wherein, following actuation, the maximum distance between the active area and the upper surface of the substrate is in the range of about 0.1 to about 10 times a dimension of the fluid-transporting feature.

35. The device of claim 34, wherein the maximum distance is about 0.5 to about 2 times the dimension of the fluid-transporting feature.

36. A valved structure comprising a conduit through which fluid can flow and a flow adjustment means for increasing, decreasing, or stopping fluid flow at an immobilization point within the conduit, wherein the flow adjustment means comprises the device of claim 1.

37. A pumping system comprising a conduit through which fluid can flow, an inlet means through which fluid is introduced into the conduit, and a pumping means for increasing, decreasing or maintaining the flow of fluid into the inlet means, wherein the pumping means comprises the device of claim 1.

38. A mixing system comprising a chamber into which a plurality of fluids may be introduced, wherein the chamber has a controllably variable shape for mixing the fluids and comprises the device of claim 1.

39. A microfluidic device comprising:

(a) a substrate having at least two fluid-transporting microfeatures formed on an upper surface thereof;

(b) an elastic sheet having an upper surface and an opposing lower surface, with the lower surface facing the upper surface of the substrate, wherein the elastic sheet (i) is immobilized with respect to the substrate at a minimum of two immobilization points, and (ii) has a deflectable active area at least partially contained between the immobilization points; and

(c) an actuation means for deflecting the active area of the elastic sheet away from the upper surface of the substrate.

40. A fluid flow control device comprising:

(a) a substrate having a plurality of fluid-transporting features formed on an upper surface thereof;

(b) an elastic sheet having an upper surface and an opposing lower surface, with the lower surface facing the upper surface of the substrate, wherein the elastic sheet (i) is

immobilized with respect to the substrate at a plurality of immobilization points, and (ii) has a plurality of deflectable active areas, wherein each of the active areas is at least partially contained between two immobilization points, and further wherein each fluid-transporting feature on the substrate surface directly faces an active area of the elastic sheet; and

(c) an actuation means for deflecting each active area of the elastic sheet away from the upper surface of the substrate.

41. The device of claim 40, wherein the actuation means allows for individual actuation of each active area.

42. The device of claim 41, wherein the actuation means is adapted to apply an electric field to each of the active area.

43. The device of claim 42, further comprising a plurality of electrodes in contact with at least one active area.

44. The device of claim 43, wherein the total number of electrodes is equal to or greater than one plus the number of active areas of the elastic sheet.

45. The device of claim 43, wherein the elastic sheet comprises an upper surface that opposes the lower surfaces of the active areas, wherein at least one electrode is located at the upper surface of the elastic sheet and at least one electrode is located at the lower surface of any of the active areas.

46. The device of claim 43, wherein one of the plurality of electrodes contacts substantially all of the active areas.

47. The device of claim 46, wherein the electrode that contacts substantially all of the active areas is located on the upper surface of the elastic sheet.

48. The device of claim 46, wherein the electrode that contacts substantially all of the active areas is located on the lower surface of the elastic sheet.

49. The device of claim 40, wherein the actuation means comprises a noncontact electrode.

50. The device of claim 49, wherein the noncontact electrode comprises ca charge source.

51. The device of claim 49, wherein the charge source comprises a field emitter.

52. A fluid flow control device comprising:

(a) a substrate having an upper surface adapted to contact a flowing fluid;

(b) an elastic sheet having an upper surface and an opposing lower surface, with the lower surface facing the upper surface of the substrate, wherein the elastic sheet (i) is immobilized with respect to the substrate at a minimum of two immobilization points, and (ii) has a deflectable active area at least partially contained between the immobilization points; and

(c) at least two electrodes in contact with the active area of elastic sheet; and

(d) a nonmechanical actuation means for deflecting the active area towards or away from the upper surface of the substrate.

53. The device of claim 52, wherein the nonmechanical actuation means is adapted to apply an electric field to the active area by charging the electrodes.

54. The device of claim 52, wherein the nonmechanical actuation means is adapted to deflect the active area towards the upper surface of the substrate.

55. A microfluidic device comprising:

(a) a substrate having at least two fluid-transporting microfeatures formed on an upper surface thereof;

(b) an elastic sheet having an upper surface and an opposing lower surface, with the lower surface facing the upper surface of the substrate, wherein the elastic sheet (i) is immobilized with respect to the substrate at a minimum of two immobilization points, and (ii) has a deflectable active area at least partially contained between the immobilization points; and

(c) at least two electrodes in contact with the active area of the elastic sheet; and

(d) a nonmechanical actuation means for deflecting each active area towards or away from the upper surface of the substrate, thereby decreasing or increasing, respectively, fluid communication with the fluid-transporting features.

56. A fluid flow control device comprising:

(a) a substrate having a plurality of fluid-transporting features formed on an upper surface thereof;

(b) an elastic sheet having an upper surface and an opposing lower surface, with the lower surface facing the upper surface of the substrate, wherein the elastic sheet (i) is immobilized with respect to the substrate at a plurality of immobilization points, and (ii) has a plurality of deflectable active areas, wherein each of the active areas is at least partially contained between two immobilization points, and further wherein each fluid-transporting feature on the substrate surface directly faces an active area of the elastic sheet; and

(c) a plurality of electrodes arranged such that at least two electrodes contact each active area; and

(d) an actuation means for deflecting each active area towards or away from the upper surface of the substrate.

57. The device of claim 56, wherein, at least one of the active areas, after actuation, is deflected towards the upper surface of the substrate.

58. The device of claim 56, wherein at least one of the active areas, after actuation, is deflected away from the upper surface of the substrate.

59. The device of claim 58, wherein at least one of the active areas, after actuation, is deflected toward the upper surface of the substrate.

60. The device of claim 56, wherein the actuation means allows for individual actuation of each active area.

61. A fluidic control device comprising:

(a) a substrate having an upper surface adapted to contact a flowing fluid; and

(b) an electroactive polymer attached to the upper surface of the substrate; the electroactive polymer comprising (i) at least one active area, and (ii) at least two electrodes in contact with each active area and arranged in a manner to cause the polymer in the active area to deflect in response to a change in electric field.

62. A method for forming a fluid flow control device, comprising the steps of:

(a) providing a substrate having an upper surface adapted to contact a flowing fluid;

(b) immobilizing an elastic sheet having an upper surface and an opposing lower surface with respect to the substrate at a minimum of two immobilization points such that the lower surface of the elastic sheet faces the upper surface of the substrate and an active area of the elastic sheet is positioned between the immobilization points; and

(c) operatively connecting an actuation means to the active area such that the active area may be deflected away from or toward the upper surface of the substrate upon operation of the actuation means.

63. The method of claim 62, further comprising, before step (b), (a') forming at least one fluid-transporting feature on the upper surface of the substrate.

64. The method of claim 63, further comprising, between steps (a') and (b), (a") ensuring that the fluid-transporting feature is located under the lower surface of the active area of the elastic sheet.

65. The method of claim 62, wherein step (b) comprises applying an adhesive between the elastic sheet and the substrate at the immobilization points.

66. The method of claim 62, further comprising, before step (c), (b') forming an electrode on a surface of the active area and operatively connecting the actuation means to the electrode during step (c).

67. The method of claim 66, wherein step (b') is carried out before step (b).

68. The method of claim 66, wherein step (b') is carried out after step (b).

69. A method for controlling fluid flow, comprising:

(a) providing a device comprising a substrate and an elastic sheet immobilized with respect thereto at a minimum of two immobilization points, wherein the elastic sheet has an active area at least partially contained between the immobilization points and in fluid-tight contact with an upper surface of the substrate; and

(b) deflecting the active area away from the upper surface of the substrate, thereby forming a fluid-transporting feature between the active area and the upper surface of the substrate.

70. A method for controlling fluid flow, comprising:

(a) providing a device comprising a substrate and an elastic sheet immobilized with respect thereto at a minimum of two immobilization points, wherein the elastic sheet has an active area at least partially contained between the immobilization points and two electrodes in contact with the active area such that fluid may flow between the active area and an upper surface of the substrate; and

(b) applying an electric potential to the electrodes to deflect the active area toward the upper surface of the substrate such that fluid-tight contact is achieved between the surfaces.